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CONSTRUCTION AND FABRICATION

SHEET METAL

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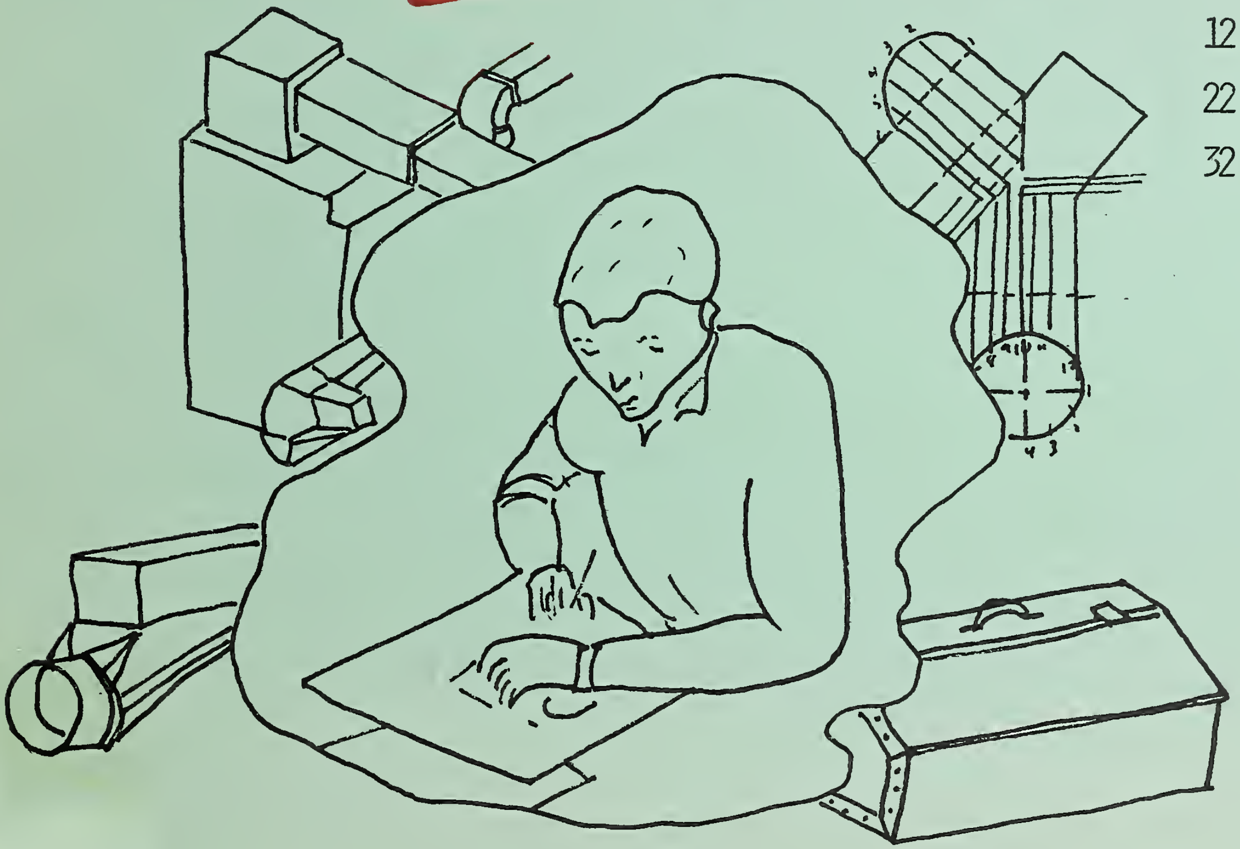

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ACKNOWLEDGMENTS

The Department of Education acknowledges with appreciation the contribution of the following Ad Hoc Committee members to the preparation of this Guide.

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School Drafting. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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I. INDUSTRIAL EDUCATION

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in Industrial Arts and Vocational Education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's knowledge of himself, his talents and his skills.

The Industrial Education course "guides" provide the teacher with an outline of the topics, generalizations and concepts selected as most relevant for the physical and mental development of the students and the logical development of the subject area in accordance with the resources of the school in both teaching personnel and facilities.

The guide leaves much scope for the teacher to develop content related to the topics, especially in writing behavioral objectives describing specific changes in student behavior anticipated from the learning tasks.

It is expected that each school district will develop a program of Industrial Education appropriate to the fulfilment of the needs of its student clientele.

II. OBJECTIVES

A. Industrial Education Objectives

The general objectives of Industrial Education complement the aims and objectives of the secondary school. The objectives of Industrial Education are to:

1. To provide students with the curriculum content designed to develop fundamental tool and procedural skills which help prepare them to enter a family of occupations.
2. To provide students with courses that serve as vehicles which help them relate their academic knowledge to vocational competencies.

3. To provide students the opportunity to develop basic competencies, both academically and in work skills to enter either a job or a post-high school institution for further education.

4. To provide students with the environment whereby they may develop sound attitudes, acceptable work habits, and achieve a feeling of accomplishment.

B. Construction and Fabrication Career Field Objectives

The Construction and Fabrication career field should provide a student an opportunity to:

1. Gain an understanding of the career field.

2. Develop skills and knowledge necessary for job entry and/or articulation with post-secondary educational institutions.

3. Develop a standard of performance acceptable to craftsmen in the trade, government and industry.

4. Study labour organization and legislation regulating work conditions.

C. Major Area of Study Objectives

The specific objectives of the Sheet Metal program are in harmony with the purposes of the Industrial Education Program and are as follows:

The Sheet Metal courses shall provide students the opportunity to:

1. Learn and work in an environment that enables them to make a realistic assessment of themselves, their interests and aptitutdes as they relate to Sheet Metal.

2. Develop habits and attitudes acceptable to the trade concerning safety, working relationships, and efficient use of time and material.

3. Develop basic competencies in the use of tools, materials and processes that may be used to gain advanced placement in apprenticeship, technical institute·programs or on the job.

III. EVALUATION

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by the students. Allowance should be made for both self and teacher evaluation and in some cases peer evaluation. Evaluation should further be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. Their categories are as follows:

a. Verbal and Written Communication
b. Personal Growth
c. Manipulative Skills

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation see the Industrial Education Handbook.

IV. ORGANIZATION

A. Guide Organization

The course guides are developed on the following pattern:

1. Topic: Each course is subdivided into a number of topics.

2. Generalization: The main generalization or "big" idea that students should learn follows each topic.

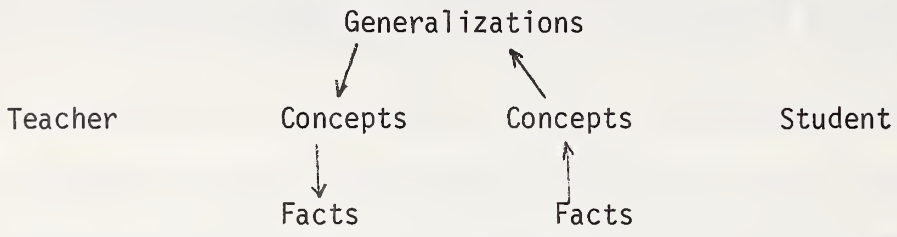
3. Concepts: The concepts divide the topic into the teaching components. They give more direction on specific areas that should be studied.

4. Behavioural Objectives: These describe specific changes in student behaviour which result from the learning tasks he performs.

   The guide gives only a few sample behavioural objectives. It is the responsibility of the teacher to develop as many behavioural objectives as he can teach in the time available.

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy whereas in learning, the student begins with facts and moves upward.



5. Suggested Activities: A few suggestions are made as to the types of activities that could be used to achieve the behavioural objectives.

6. Resource Materials: This column suggests where materials may be obtained.

B. Program Organization

1. Program Description

The Sheet Metal modules give students the opportunity to learn the theory and skills necessary in the sheet metal trade. Students will learn to identify and use the tools and materials commonly associated with the trade. They will learn to lay out patterns, shape, form and assemble sheet metal and plastic products. Their projects may vary from the standard pieces used in the trade to metal cabinets. In the process they will learn about the trade, job opportunities, business practices and enough skills to get a job, go into apprenticeship or enhance their avocational interests.

2. Program Major Organization

The major consists of six five-credit modules and one module of 5-10 credits. Entry into the major is through one of Materials 10, General Technology 10 or Sheet Metal 12. Following the Sheet Metal 22B module students may advance to any of the following modules which are non-sequential 22C, 32A or 32B.

32C is the last course in the 35-credit sequence and can be used to:

a. Provide greater depth to a module taken previously.

b. Take work in actual construction under a work experience plan whereby the sheet metal teacher supervises the student on the job. The student must be under the supervision of a journeyman while on the job.

In addition to the modules set out in the major for Sheet Metal a student may select modules designated as minors. These are normally the first level or introductory course of the area, e.g. Welding would be Welding 12.

A student wishing to meet the requirements of the Apprenticeship Branch must complete all seven modules in the major area.

Some students, however, may take only a few modules in a mjor area as a supplement to their academic program or they may broaden their selection to other career fields. The scope of the Industrial Education program allows the flexibility necessary for the program to be tailored to meet the interests and needs of the individual class or student.

The chart on Page 6 gives a graphic description of the Sheet Metal program. Each module is identified and the sequences are indicated by lines, e.g. After a student has completed one of Sheet Metal 12 or Materials 10 or General Technology 10 he/she may advance to any module to which the solid line leads. In this case to 22A. He must then take 22B before advancing to any one of 22C, 32A or 32B. Only 32C requires that all modules before it be completed.

Once a student has enroled in a "22" or second level course he may also select modules from the minor fields.

Students may find some of the courses in the listed related fields beneficial to their career program development. They are encouraged to take some of these to complement their program.

3. Facility Organization

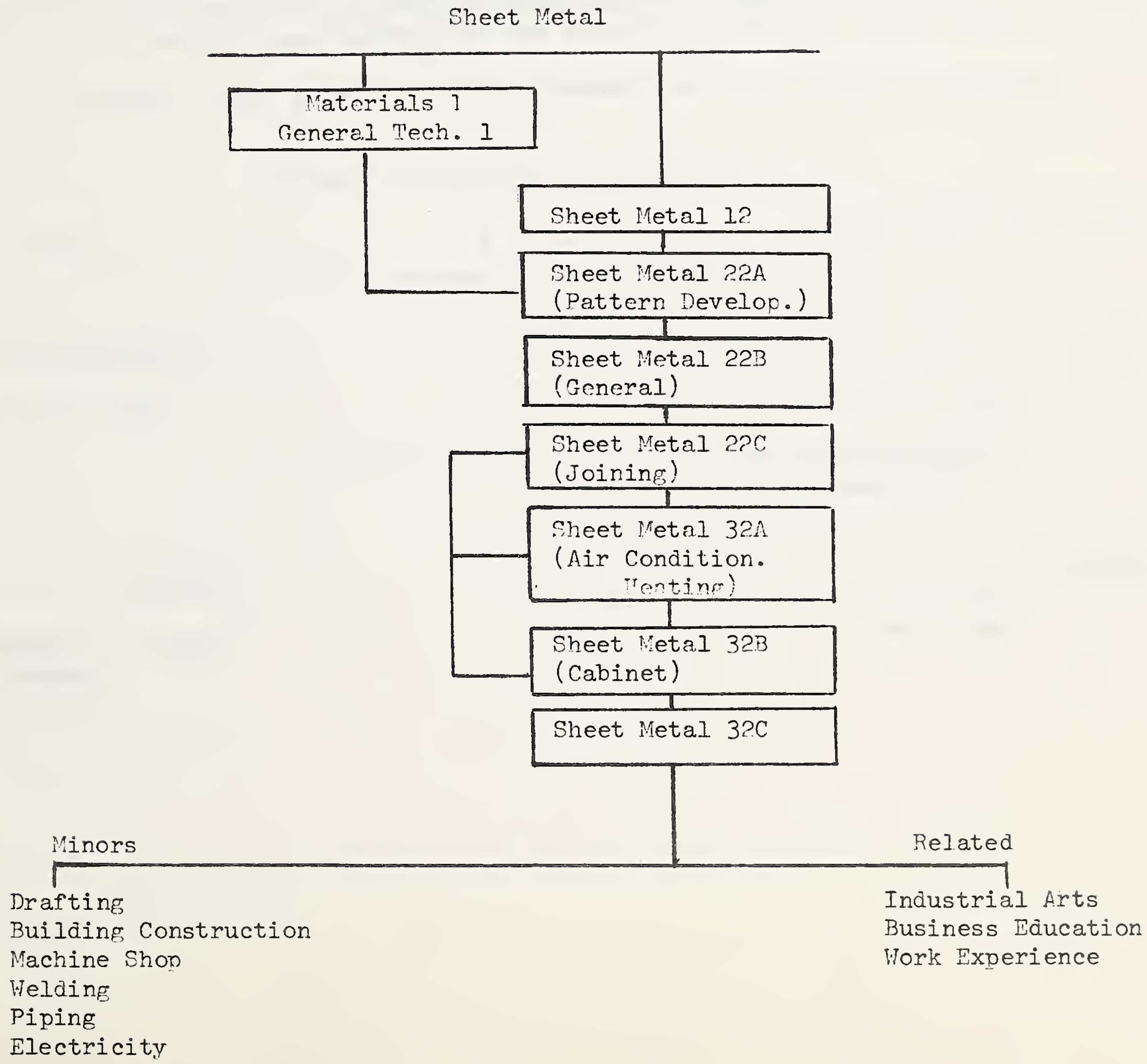
The organization of the physical facilities is in part determined by the original plan. There are however adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab or shop is organized. While most of the shops in Alberta are designed for 16 to 20 students a number of factors must be considered in the final assignment of class load. These factors include:

1. physical size of the shop or laboratory
2. type of student
3. amount of equipment
4. type of programming
5. type of course
6. training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class loads are determined.

CAREER FIELD

CONSTRUCTION AND FABRICATION



V. CAREER OPPORTUNITIES

Sheet Metal is a program designed to give students first year proficiency in the Sheet Metal trade and thereby reduce the amount of time required to serve as an apprentice by one year. Students must complete the course and the apprenticeship exams.

Successful students may look foreward to the following career opportunities.

Sheet Metal 12-22-32 (35 credits)

Post High School Studies

N. A. I. T. or S. A. I. T.

- Sheet Metal Mechanic
- Air Conditioning and Refrigeration

UNIVERSITY

- Engineering
- Education

Career Entry

Apprenticeship as:

- Sheet Metal Mechanic

Engineer

Teacher - Institutes
Community Colleges
High School

VI. CONSTRUCTION AND FABRICATION

1. Sheet Metal 12

INTRODUCTION

The Sheet Metal 12 course is a 5-credit course.

The general objective of this course is to offer the student a sampling of the type of work to be found in this career area, and thus, give the student the knowledge necessary to make an informed decision about future studies.

I. OBJECTIVES

The specific objectives of this course are:

1. to give students an understanding of the sheet metal workers role in industrial society.
2. to introduce the students to the safe use of tools and acceptable procedures basic to the sheet metal trade.

II. CONTENT SUMMARY

1. Career field study
   -related occupations
   -employment opportunities
   -trade organization

2. Safety

3. Industrial structures
   -social structure of industry
   -collective bargaining
   -apprenticeship

4. Measurement
   -systems; metric, English
   -measuring instruments
   -layout instruments

5. Tool processes
   - mechanical removal of metal
   - thermal removal
   - chemical removal
   - combining material; fastening methods
   - forming

6. Elements of pattern development
   - simple pattern development
   - parallel-line development
   - radical-line development

III. REFERENCES AND RESOURCE MATERIALS

* Bruce, Leroy F., *Sheet Metal Shop Practice*. Chicago, Illinois: American Technical Society, 1966

Daugherty, James S., *Sheet Metal Pattern Drafting and Shop Problems*. Peoria, Illinois: Chas. A. Bennett Company Incorporated Publishers, 1961.

* Delmar Publishers, (eds.). *Hand Processes*. Albany, New York: Delmar Publishers, 1964.

* Delmar Publishers, (eds.). *Measurement and Layout*. Albany, New York: Delmar Publishers, 1964.

* Delmar Publishers, (eds.). *Machine Processes*. Albany, New York: Delmar Publishers, 1964.

Delmar Publishers, (eds.). *Teacher's Manual for Sheet Metal Work*. Albany, New York: Delmar Publishers, 1964.

* Most Useful

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

Topic I: CAREER FIELD STUDY

Major: Sheet Metal

Generalization A: There are many occupations within and related to the career field of construction and fabrication.

Course: Sheet Metal 12, 12A

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Career field occupations	1	The student will: a. list the various occupations available in the career field plus entry requirements (certification). b. list courses offered in his school system in the career field.	Lectures Class discussions Guest speakers Field trips Occupational Monographs Video tapes Slides Movies	
2. Related occupations	1/2	SAME AS ABOVE		
3. Employment opportunities	1 1/2	a. be aware of the opportunities in his career field.	Guest speaker from industry	

Notes:

Topic II: SAFETY

Generalization B: A knowledge and practice of safety is essential in all shop and laboratory activities.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Unsafe act	1	The student will: a. analyze two activities for unsafe acts.	Films Demonstrations Speaker from the Workman's Compensation Board	
2. Unsafe conditions		a. analyze a tool operation for unsafe conditions		

Notes:

Topic III: INDUSTRIAL FORCES

Generalization C: In today's complex industrial society it is necessary for a worker to be aware of some of the forces which often affect him; social structure of industry, collective bargaining and apprenticeship.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Social structure of industry	2	The student will: a. describe industrial organization, and the worker's role in production and social relations within this career field.	Guest speaker Films	
2. Collective bargaining	2	a. define the meaning of trade unions, and how they relate to the executive and to the worker in this career field.	Guest speaker	
3. Apprenticeship	2	a. describe the structure of the apprenticeship board, and its relationship with the employer and the employee within this career field.	Guest speaker	

Notes:

Generalization D: Measurement and layout are essential in the manufacture or repair of most products.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Measurement systems (i) metric (ii) English	1 1/2	The student will: a. measure and lay out measurements accurately to within 1 mm. b. use the metric system of measurement in most situations. Convert to English units only as needed.	Lecture Films Charts Shop work	
2. Measuring instruments	4	a. demonstrate pride in the care and use of measuring equipment and will utilize the following: - steel rule - circumference rule - steel square - metal thickness gauge - wire gauge - micrometer - combination square.		
3. Layout instruments	4	a. correctly utilize the following layout instruments - dividers - trammel points - scratch awl - prick punch - centre punch - marking gauge.		

Notes:

Topic V: TOOL PROCESSES

Generalization E: Through the use of tools, materials are shaped by removal, combining and forming.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Mechanical removal (i.) shearing (ii.) fracture	4	The student will: a. describe the various "shearing" devices used in sheet metal work: (i.) Snips (various kinds) (ii.) Floor shears - squaring - gap - power (iii.) Throatless shears (iv.) Portable power shears - unishear - nibbler (v.) Chisels (vi.) Drill bits (vii.) Sanders - disc - belt (viii.) Grinder		
2. Thermal removal	1	a. use the oxyacetylene cutting process.	Demonstration Lecture	
3. Chemical removal				

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Combining material	15	a. identify the various techniques used in "combining material" in sheet metal industry - seaming - riveting - welding - soldering.		
5. Forming	8	a. demonstrate the care, use and maintenance of the following sheet metal "forming" tools: (i.) Bending machines - standard hand brake - pan brake - barfolder - cleatbender - power brake (ii.) Lock former (iii.) Stakes (iv.) Slip rollers.		

Notes:

Topic VI: ELEMENTS OF PATTERN DEVELOPMENT

Generalization F: All objects have surfaces which can be reduced to flat patterns.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Simple pattern development	30	The student will: a. lay out and make up objects having "simple" surfaces: eg. - rectangular pan - round pipe - square elbow.		
2. Parallel-line development	40	a. use this system to lay out at least one typical object: eg. - sugar scoop - two intersecting cylinders.		
3. Radial-line development	11	a. as in concept two above: eg. - funnel.		

Notes:

VI. CONSTRUCTION AND FABRICATION

2. Sheet Metal 22A

Pattern Development

INTRODUCTION

Students may advance to Sheet Metal 22A following completion of an introductory course in Materials 10, General Technology 10 or Sheet Metal 12. Sheet Metal 22A is pre-requisite for 22B.

I. OBJECTIVES

The objective of Sheet Metal 22A is

-to introduce the students to the principles of pattern development.

II. CONTENT SUMMARY

1. Principles of sheet metal layout
   - simple pattern development
   - parallel line development
   - radical line development
   - triangulation

2. Development of metal layouts.

III. REFERENCES

In addition to the references listed for Sheet Metal 12 the following will be helpful:

Haim, G. *Manual for Plastics Welding Polyvinyl Chloride*. New York: Chemical Publishing Company, 1960.

* Kaberlein, Joseph J. *Air Conditioning Metal Layout*. Milwaukee, Wisconsin: Bruce Publishers Company, 1961.

* Kaberlein, Joseph J. *Short Cuts for Round Layouts*. Milwaukee, Wisconsin: Bruce Publishers Company, 1961.

* Kaberlein, Joseph J. *Triangulation Short-Cut Layouts*. Milwaukee, Wisconsin: Bruce Publishers Company, 1961.

Kaminsky, S. J. and J. A. Williams. *Handbook for Welding and Fabricating Thermoplastic Materials.* Norwood, Massachusetts: Kamweld Products Company.

* Neundorf and Stevens. *Sheet Metal Practices, Part I.* Toronto, Ontario: McGraw-Hill Book Company, 1962.

Sheet Metal and Air Conditioning Contractors National Association. *S. M. and Air Conditioning High Pressure Duct Manual; S.M. and Air Conditioning Architectual Sheet Metal Manual.* Elgin, Illinois: S.M.A.C. National Association.

Sheet Metal Workers International Association. *The Sheet Metal Craftsman.* Washington, D.C.: Merkle Press Incorporated, 1963.

* Most Useful.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

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Topic I: PRINCIPLES OF SHEET METAL LAYOUT

Major: Sheet Metal

Course: Sheet Metal 22A
Pattern Development

Generalization A: All objects have surfaces which can be reduced to flat patterns.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Simple pattern development	20	The student will: a. make patterns of surfaces involving simple shapes: - rectangular surfaces - cylinders - hexagonal surfaces etc. b. calculate and lay out the necessary seams and hems on patterns.	The formal drafting part of this module should be done in a drafting room with emphasis being placed on the manufacture of some of the items in a shop situation.	
2. Parallel-line development	45	a. make patterns of surfaces of the following typical shapes: - mitered cylinder - round elbow - cylinder to cylinder intersections.		
3. Radial-line development	20	a. develop patterns related to the surface of the right cone.	Films Field Trips	

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Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
4. Triangulation	45	a. develop patterns for objects with surfaces which lend themselves to a triangulation method: eg. - (i.) a variety of rectangle to round transitions - (ii.) the oblique cone.		

Notes:

VI. CONSTRUCTION AND FABRICATION

3. Sheet Metal 22B

General Practices

INTRODUCTION

Students may advance to Sheet Metal 22B or take it concurrently with 22A.

I. OBJECTIVES

The objective of Sheet Metal 22B is:

-to introduce the students to the basic methods of forming and fabricating components that are basic to the general sheet metal shop.

II. CONTENT SUMMARY

1. General sheet metal work
   -tools and equipment
   -rectangular objects
   -conical objects

III. REFERENCES

As previously listed.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

Topic I: GENERAL SHEET METAL WORK

Major: Sheet Metal

Generalization A: Because of considerations involving design, cost and material properties, certain items required by industry are best realized through sheet metal techniques.

Course: Sheet Metal 22B
General sheet metal work

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Rectangular objects	40	The student will: a. demonstrate his knowledge of the layout and related theory of the following: (i.) several methods for constructing rectangular pans (ii.) a variety of rectangular duct fittings with connectors (iii.) metal clad doors and frames.	 Field trips Field trips	
2. Cylindrical objects	70	a. demonstrate his knowledge of theory by laying out the following items: - roof jack - round pipe - chimney hood - round elbow - round offset.		
3. Conical objects	20	a. lay out patterns and manufacture articles related to the right cone.		

Notes:

VI. CONSTRUCTION AND FABRICATION

4. Sheet Metal 220

Joining

INTRODUCTION

Students may advance to Sheet Metal 22C following completion of or concurrently with 22B.

I. OBJECTIVES

The objective of Sheet Metal 22C is

-to introduce the students to methods of joining and fastening sheet metal products.

II. CONTENT SUMMARY

1. Joining sheet metal
    - mechanical methods of joining
    - adhesion
    - cohesion
    - projects applying methods of joining

III. REFERENCES

As previously listed.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: JOINING SHEET METAL

Major: Sheet Metal

Generalization A: The main methods of joining sheet materials involve mechanical methods, adhesion and cohesion.

Course: Sheet Metal 22C
Sheet metal welding and joining

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Mechanical methods of joining	40	The student will: a. list the theoretical and practical advantages of: - bolts - rivets - seams. b. produce projects applying mechanical methods of joining.		
2. Adhesion	20	a. correctly solder various metals.		
3. Cohesion	70	a. demonstrate his knowledge of and correctly use the following: - oxy - acetylene welding - A.C. and D.C. welding - TIG and MIG welding - carbon arc welding - welding of plastic materials		

Notes:

VI. CONSTRUCTION AND FABRICATION

5. Sheet Metal 324

Air Conditioning and Residential Heating

INTRODUCTION

Students must have completed the "22" series before advancing to 32A.

I. OBJECTIVE

The objective of Sheet Metal 32A is:

-to introduce the students to the fundamentals of heating and air-conditioning.

II. CONTENT SUMMARY

1. Heating and air-conditioning
   -air-conditioning systems; types, installations, controls
   -heating systems; fittings, installations, controls

III. REFERENCES

As previously listed.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: HEATING AND AIR CONDITIONING

Major: Sheet Metal

Generalization A: Environmental comfort within dwellings is obtained through air conditioning and heating systems.

Course: Sheet Metal 32A
Air conditioning and residential heating

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Air conditioning systems	65	The student will: a. analyze and be able to explain air conditioning systems, including the following areas: - types of fittings - controlled humidity - controls - installations.	Field trips Films	
2. Heating systems	65	a. analyze gravity and forced air systems, including: - fittings - controls - installations.		

Notes:

IV. CONSTRUCTION AND FABRICATION

6. Sheet Metal 32B

Cabinet Work

INTRODUCTION

Students may advance to Sheet Metal 32B after completion of the "22" series.

I. OBJECTIVE

The objective of Sheet Metal 32B is:

-to introduce students to cabinet work related to the sheet metal trade.

II. CONTENT SUMMARY

1. Introduction to sheet metal cabinet work
   -hospital equipment
   -general cabinet work
   -layout and manufacture one cabinet type project

III. REFERENCES

As previously listed.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: INTRODUCTION TO SHEET METAL CABINET WORK AND RELATED EQUIPMENT.

Major: Sheet Metal

Generalization A: Because of the properties of certain metals, there is a demand for sheet metal products by various industries and institutions.

Course: Sheet Metal 32B Cabinet work

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Hospital equipment	20	The student will: a. list the methods of manufacture and the kinds of units and related equipment required in hospitals. Typical items should include: - sinks - table tops - kick plates - portable food carrying equipment - laundry chutes.	Lab work Field trips Demonstrations	
2. Restaurant equipment	20	a. identify the kinds of units required and basic methods of construction of the following: - dishtables - sinks - refrigeration units - salad tables - coffee urn stands - food line-ups - tray rails - canopies - store fronts.		

Notes:

Generalization

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. General cabinet work	10	a. describe the construction of the following: - metal desk - filing cabinet - metal tables - mechanic's tool box - barbeque.		
	80	b. lay out and manufacture an article, cabinet in nature, at the discretion of the instructor.		

otes:

VI. CONSTRUCTION AND FABRICATION

7. Sheet Metal 320

INTRODUCTION

After a student has completed 30 credits in the Sheet Metal series he may advance to 32C.

Sheet Metal 32C

The last module of the Sheet Metal sequence is open to students who have completed 30 credits or six modules in the major.

The 125 hours of instruction time available in this module may be used to:

a. provide greater depth to a module taken previously. Individual students, groups of students or whole classes may elect to study an area in more detail. This in-depth study could be in Pattern Development, Air Conditioning, Heating or any of the modules named in the Sheet Metal sequence.

b. engage in actual Sheet Metal work supervised by the Sheet Metal teacher as a coordinator of the student and a Journeyman on the job.

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